

CLAIMS

What is claimed is:

- 1 1. A system for identifying pixels inside a graphics primitive of a raster image
2 comprising:
3 a memory for storing a raster image; and
4 a graphics engine coupled to the memory and including a pipeline structure, the
5 pipeline structure receiving information related to polygonal portions of the raster
6 image from the memory and information related to graphics primitives from a source
7 for determining whether a polygonal portion of the raster image is at least partly inside
8 the graphics primitive.
- 1 2. The system of claim 1 wherein the pipeline structure further comprises a
2 predetermined number of sequential logic circuits and a predetermined number of
3 parallel logic circuits.
- 1 3. The system of claim 1 wherein the pipeline structure divides the polygonal
2 portion into a predetermined number of polygonal subportions if the polygonal portion
3 is at least partly inside the graphics primitive.
- 1 4. The system of claim 1 wherein the pipeline structure determines whether the
2 polygonal portion of the raster image is at least partly inside the graphics primitive by
3 evaluation of edge functions of the graphic primitive.

1 5. The system of claim 4 wherein each edge function of the graphics primitive is
2 based on a general edge function, $e(x, y) = e_0 + n_x x + n_y y$ where e_0 is a constant, n_x is the
3 x-component of a normal vector \mathbf{n} which is normal to an edge of the primitive and n_y is
4 the y-component of the normal vector \mathbf{n} .

1 6. The system of claim 4 wherein the edge function is evaluated at a corner vertex
2 of the polygonal portion, the corner vertex being farthest in a positive direction from a
3 primitive edge associated with the edge function.

1 7. The system of claim 2 wherein the pipeline structure is configured such that the
2 sequential logic circuits are coupled together in series followed by the parallel logic
3 circuits coupled together in parallel.

1 8. The system of claim 2 wherein the pipeline structure comprises seven sequential
2 logic circuits connect in series and seven parallel logic circuits coupled together in a
3 multi-stage pyramid structure.

1 9. The system of claim 3 wherein the pipeline structure determines the two
2 polygonal subportions by determining midpoint values of two opposite sides of the
3 polygonal portion of the raster image and using the midpoint values as vertices of the
4 two polygonal subportions.

1 10. The system of claim 1 wherein the pipeline structure further comprises a
2 predetermined number of pixel engines for determining attribute values associated
3 with each pixel.

1 11. The system of claim 1 wherein the polygonal portion of a raster image has a
2 width ΔX and a height ΔY , each of the width ΔX and the height ΔY having a value of
3 2^m .

1 12. A method of identifying pixels inside a graphics primitive of a raster image,
2 comprising the steps of:
3 (a) determining whether a polygonal portion of the raster image is at least partly
4 inside the graphics primitive;
5 (b) dividing the polygonal portion of the raster image into a predetermined
6 number of polygonal subportions if the polygonal portion of the raster image is at least
7 partly inside the graphics primitive;
8 (c) determining whether each polygonal subportion of the raster image is at least
9 partly inside the graphics primitive; and
10 (d) further dividing the polygonal subportion into a predetermined number of
11 polygonal subportions if the polygonal subportion is at least partly inside the graphics
12 primitive and is larger than a pixel.

1 13. The method of claim 12 further comprising the step of recursively performing (c)
2 and (d) until there are no more polygonal subportions that are at least partly inside the
3 graphics primitive.

1 14. The method of claim 12, wherein the determining step (a) further comprises the
2 step of receiving a plurality of values for corner vertices of the polygonal portion and
3 arithmetic edge functions related to the graphic primitive having a coordinate reference
4 frame located at a geometric center of the polygonal portion, the arithmetic edge
5 function corresponding to an edge of the graphics primitive.

1 15. The method of claim 14, wherein the determining step (a) further comprises the
2 step of evaluating an arithmetic edge function received at a corner vertex of the
3 polygonal portion, the corner vertex being farthest in a positive direction relative to the
4 corresponding edge of the graphics primitive.

1 16. The method of claim 15 wherein the polygonal portion is at least partly inside the
2 graphics primitive if all arithmetic edge functions evaluated are positive.

1 17. The method of claim 12 wherein the dividing step (b) further comprises the step
2 dividing the polygonal portion into two polygonal subportions by determining
3 midpoint values of two opposite sides of the polygonal portion.

1 18. The method of claim 12 wherein the dividing step (b) further comprises the step
2 of sequentially deriving two new sets of arithmetic edge functions associated with a
3 translated coordinate reference frame located at a geometric center of a corresponding
4 one of the polygonal subportions.

1 19. The method of claim 12 wherein the dividing step (b) further comprises the step
2 of sequentially outputting multiple sets of information, wherein each set of information
3 includes corner vertices of one of the created polygonal subportions and a
4 corresponding new set of derived arithmetic edge functions.

1 20. An electronically-readable medium having embodied thereon a program, the
2 program being executable by a machine to perform method steps for identifying pixels
3 inside graphics primitives of a raster image, the method steps comprising:
4 (a) determining whether a polygonal portion of the raster image is at least partly
5 inside the graphics primitive;
6 (b) dividing the polygonal portion into a predetermined number of polygonal
7 subportions if the polygonal portion is at least partly inside the graphics primitive;
8 (c) determining whether the polygonal subportion is at least partly inside the
9 graphics primitive for each polygonal subportion; and
10 (d) dividing the polygonal subportion into a predetermined number of
11 polygonal subportions if the polygonal subportion is at least partly inside the graphics
12 primitive and the polygonal subportion is larger than a pixel.

1 21. The electronically-readable medium of claim 20 further comprising the step of
2 recursively performing steps (c) and (d) for each polygonal subportion larger than a
3 pixel that is at least partly inside the graphics primitive.

1 22. A method of identifying pixels inside a graphics primitive of a raster image
2 comprising the steps of:
3 selecting a tile including a pixel;
4 determining if a portion of the tile is within the graphics primitive;
5 dividing the tile into subtiles if a portion of the tile is within the graphics
6 primitive; and
7 recursively dividing each subtile having a portion within the graphics primitive
8 until the subtile is equal in size to a pixel.

- 1 23. The method of claim 22 further comprising the step of disregarding the tile or
2 subtitle from subsequent decomposition if the tile or subtitle is outside of the graphics
3 primitive.
- 1 24. The method of claim 22 wherein the step of determining further comprises
2 evaluating the tile at a corner vertex which is farthest in a positive direction relative to a
3 current edge of the graphics primitive.
- 1 25. The method of claim 22 wherein the step of recursively dividing further
2 comprises determining if the subtitle is at least partly within the graphics primitive by
3 evaluating the subtitle at a corner vertex which is farthest in a positive direction relative
4 to a current edge of the graphics primitive.
- 1 26. An electronically-readable medium having embodied thereon a program, the
2 program being executable by a machine to perform method steps for identifying pixels
3 inside graphics primitives of a raster image, the method steps comprising:
4 selecting a tile including pixels;
5 determining if a portion of the tile is within the graphics primitive;
6 dividing the tile into subtiles if a portion of the tile is within the graphics
7 primitive; and
8 recursively dividing each subtitle having a portion within the graphics primitive
9 until the subtitle is equal in size to a pixel.